



# **NDIA/Army Conference on Armaments for the Army Transformation**

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**June 19, 2001**

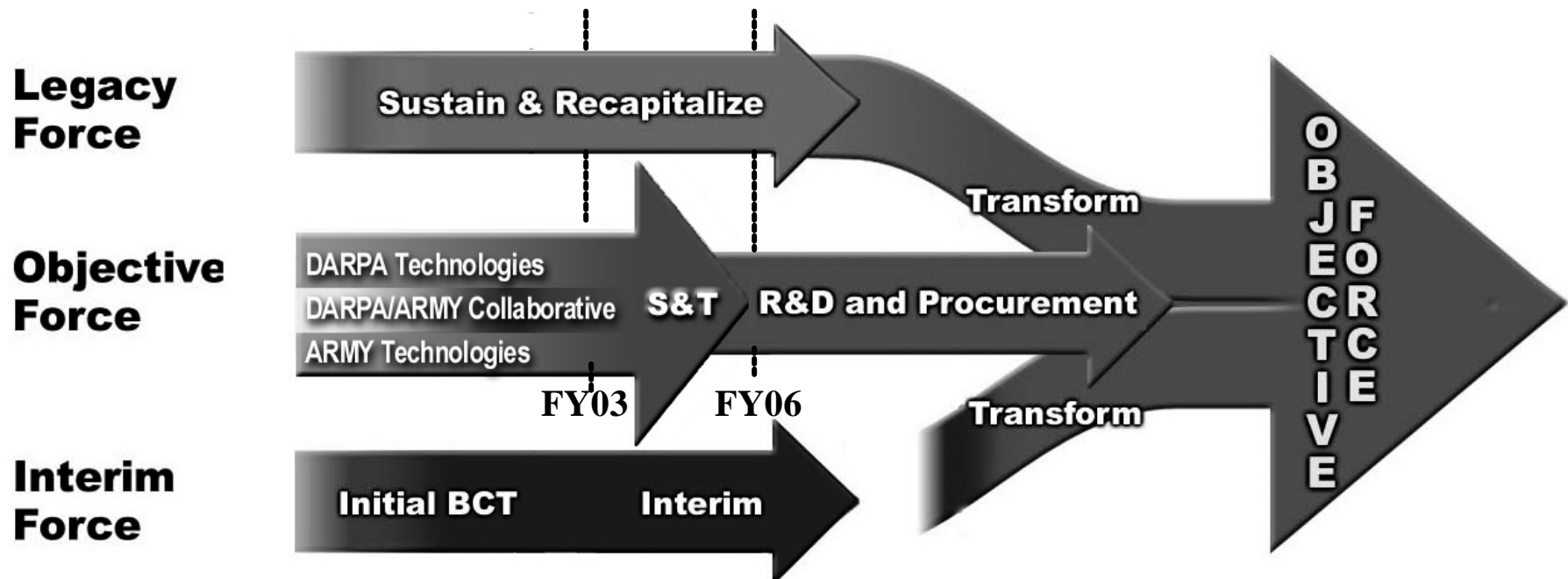
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## Report Documentation Page

<b>Report Date</b> 19JUN2001	<b>Report Type</b> N/A	<b>Dates Covered (from... to)</b> -
<b>Title and Subtitle</b> NDIA/Army Conference on Armaments for the Army Transformation	<b>Contract Number</b>	
	<b>Grant Number</b>	
	<b>Program Element Number</b>	
<b>Author(s)</b> Alexander, Jane A.	<b>Project Number</b>	
	<b>Task Number</b>	
	<b>Work Unit Number</b>	
<b>Performing Organization Name(s) and Address(es)</b> DARPA	<b>Performing Organization Report Number</b>	
<b>Sponsoring/Monitoring Agency Name(s) and Address(es)</b> NDIA (National Defense Industrial Association 2111 Wilson Blvd., Ste. 400 Arlington, VA 22201-3061	<b>Sponsor/Monitor's Acronym(s)</b>	
	<b>Sponsor/Monitor's Report Number(s)</b>	
<b>Distribution/Availability Statement</b> Approved for public release, distribution unlimited		
<b>Supplementary Notes</b> Proceedings from Armaments for the Army Transformation Conference, 18-20 June 2001 sponsored by NDIA		
<b>Abstract</b>		
<b>Subject Terms</b>		
<b>Report Classification</b> unclassified	<b>Classification of this page</b> unclassified	
<b>Classification of Abstract</b> unclassified	<b>Limitation of Abstract</b> UU	
<b>Number of Pages</b> 32		



# The Army Transformation



*... Responsive, Deployable, Agile,  
Versatile, Lethal, Survivable, Sustainable.*

# What is the FCS Program?



- *A collaborative program between DARPA and the US Army to evaluate and competitively demonstrate Future Combat Systems*
- **The FCS Program will:**
  - Define and validate FCS design/operational concepts using modeling and simulation and surrogate exercises
  - Develop key enabling technologies for distributed lighter forces
  - Fabricate and test a multi-mission FCS Demonstrator to facilitate EMD and production

***Simultaneously conduct a system/concept definition and design addressing the enabling technologies, allowing a critical decision in FY 03 and the creation of a systems demonstrator by FY 06***



# Why DARPA?



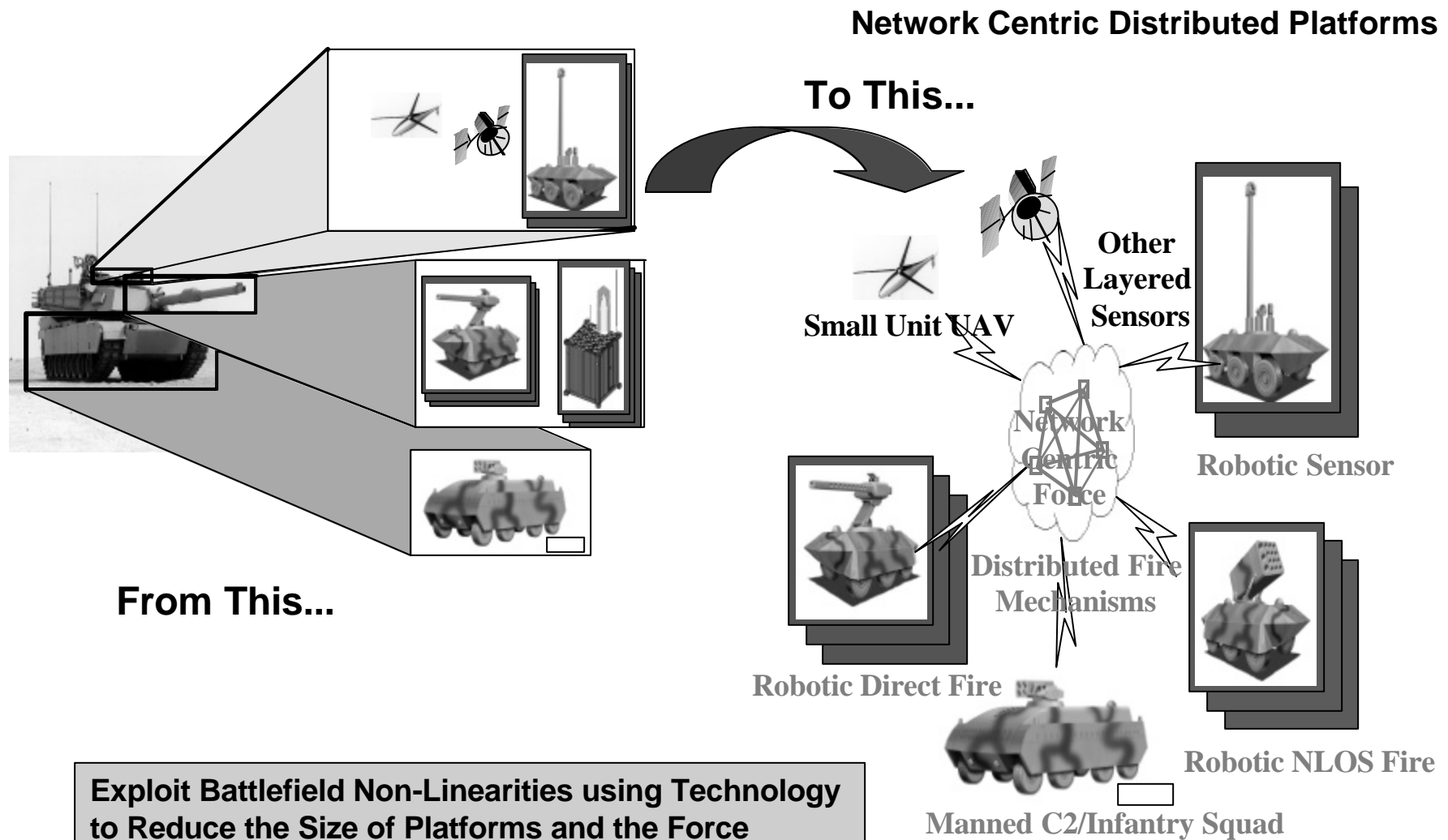
- **DARPA's role in DoD is to be the technical enabler for innovation for national security**
- **DARPA serves as a temporary independent agent to catalyze radical innovation for the Army**
- **FCS must go back to the Army for full development**

# The Challenge



- **What makes the DARPA/Army Collaborative Demonstration Program so challenging?**
  - **Short-term, parallel development of system-of-systems concepts and key technology efforts**
  - **New operating concepts are being developed concurrently**
  - **System concept incorporates network warfare and relies heavily on robotics**

# Baseline System Concept



# FCS . . Responsive, Deployable, Agile, Versatile, Lethal, Survivable, Sustainable



*UAV monitors distant activities.  
MAVs launched for closer observation*

*Loitering munition identifies and  
locks on to BLOS target*

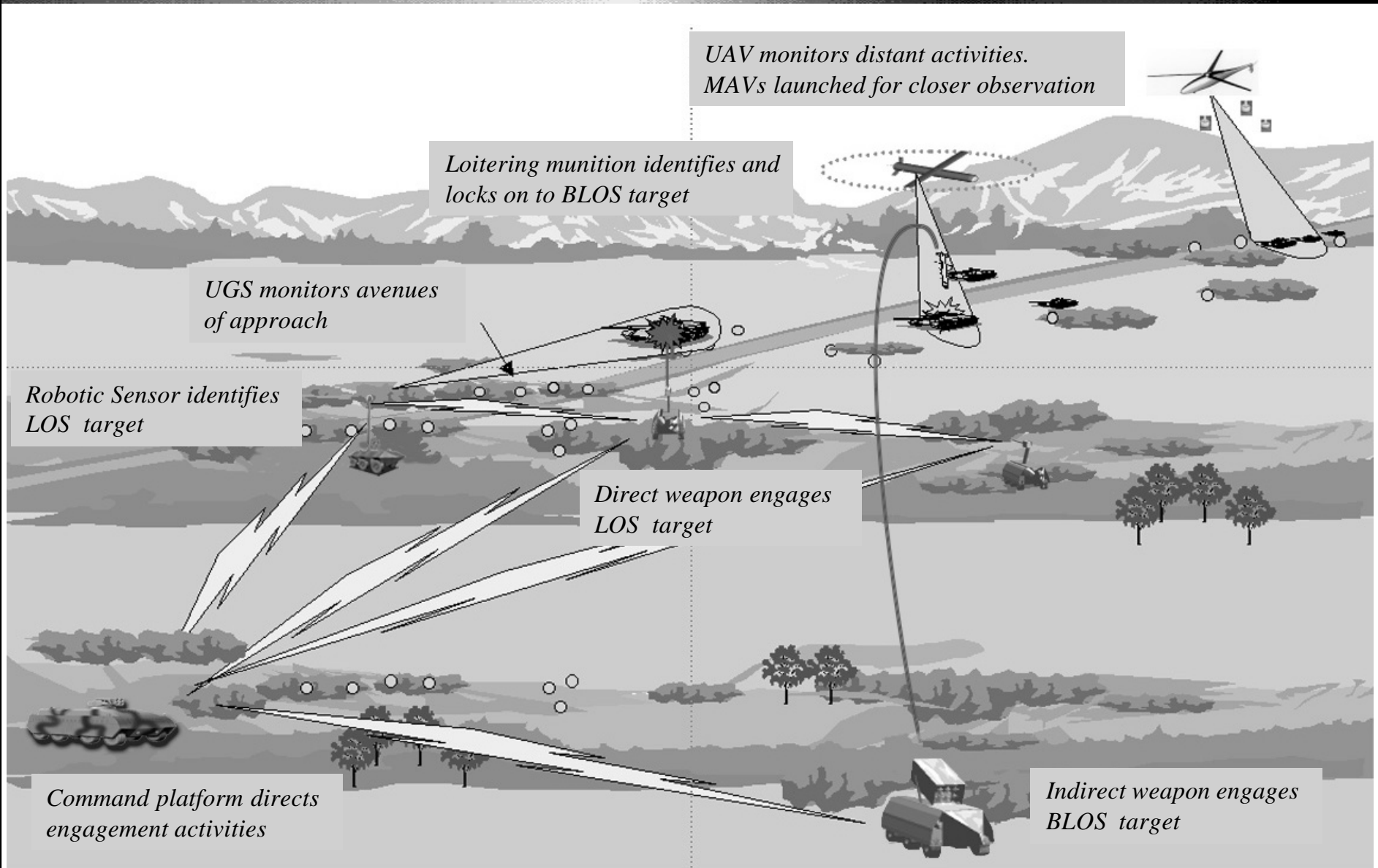
*UGS monitors avenues  
of approach*

*Robotic Sensor identifies  
LOS target*

*Direct weapon engages  
LOS target*

*Command platform directs  
engagement activities*

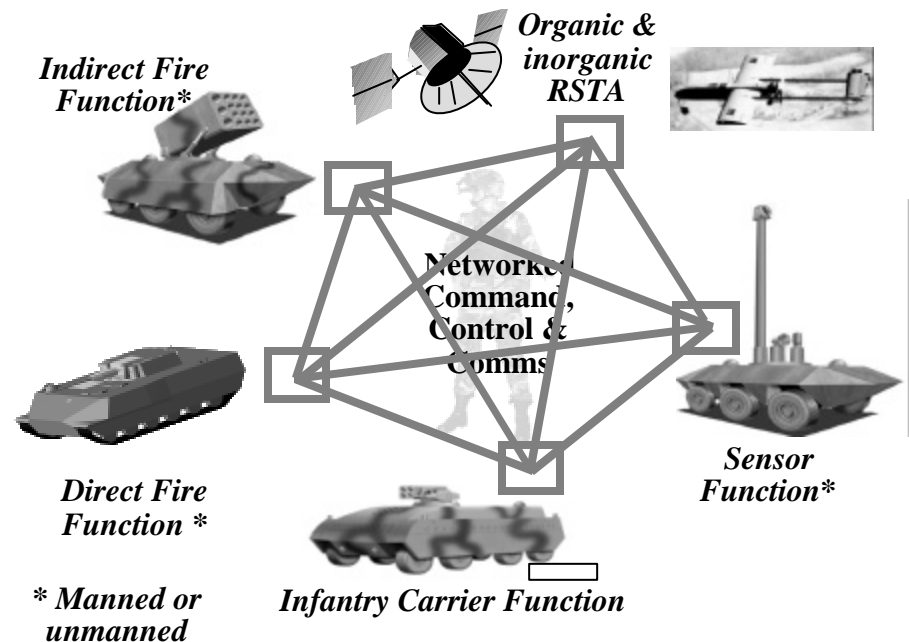
*Indirect weapon engages  
BLOS target*



# What Makes FCS Different?

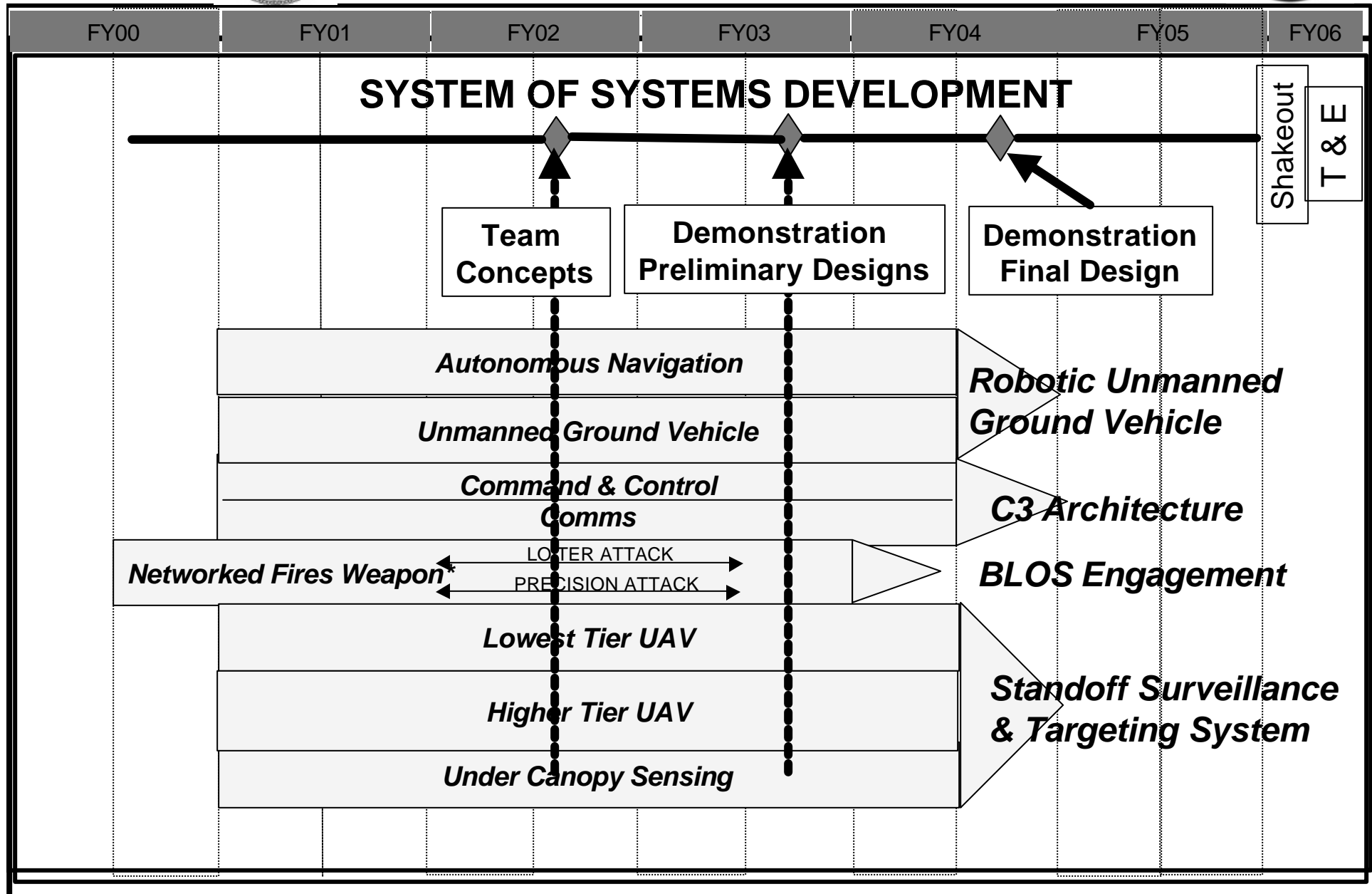


- **Network centric**
  - Know precisely, in real-time, location of all friendly and enemy forces
- **Robotics integrated into force**
  - Amplify capability of manned elements
  - Multi-functional (RSTA, armed, sustainment)
- **Increased reliance on extended range engagement**
  - Organic plus strategic and tactical support
  - Long range ISR and precision fires
- **Capable of air-mobile operations**
  - Commercial and minimum DoD strategic and tactical lift

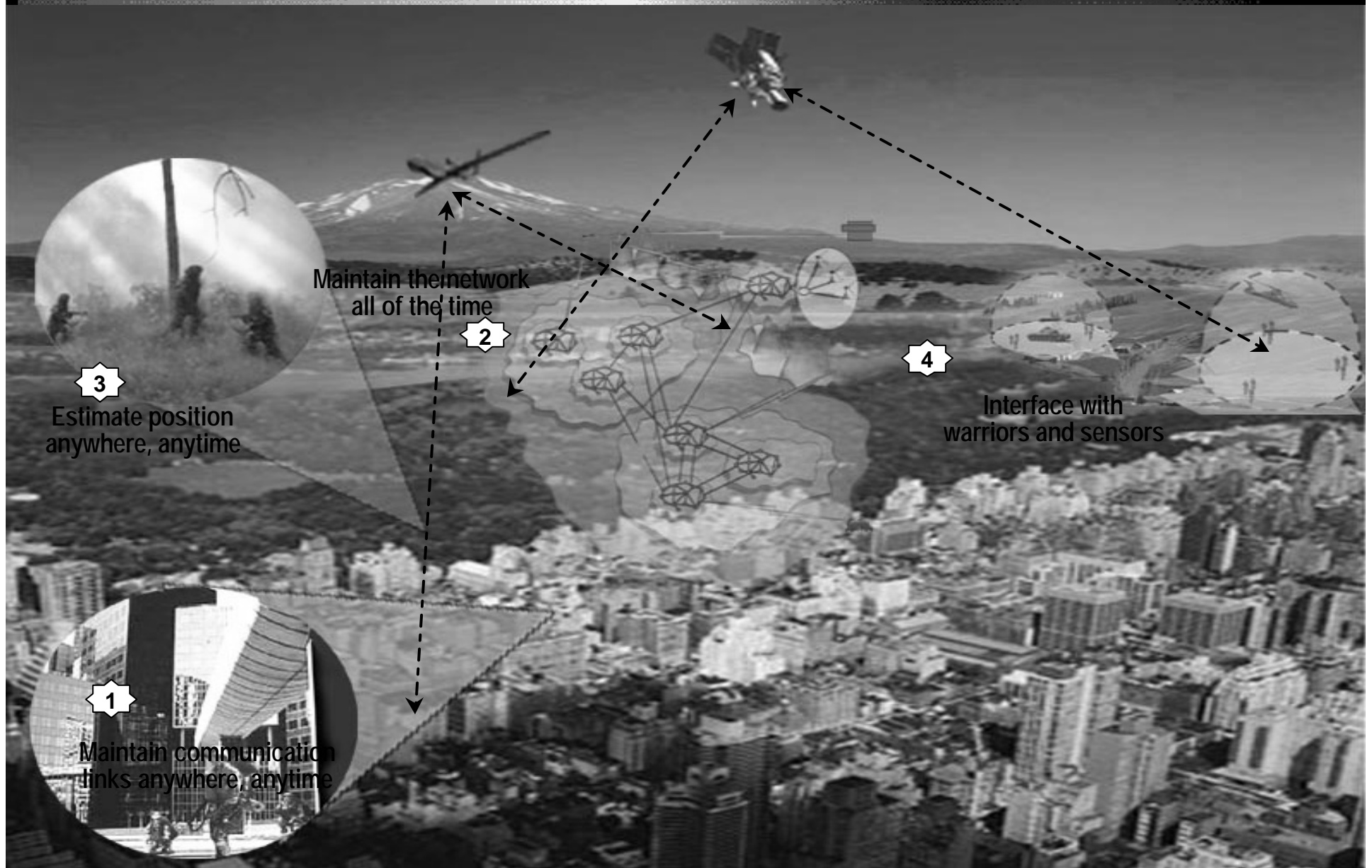




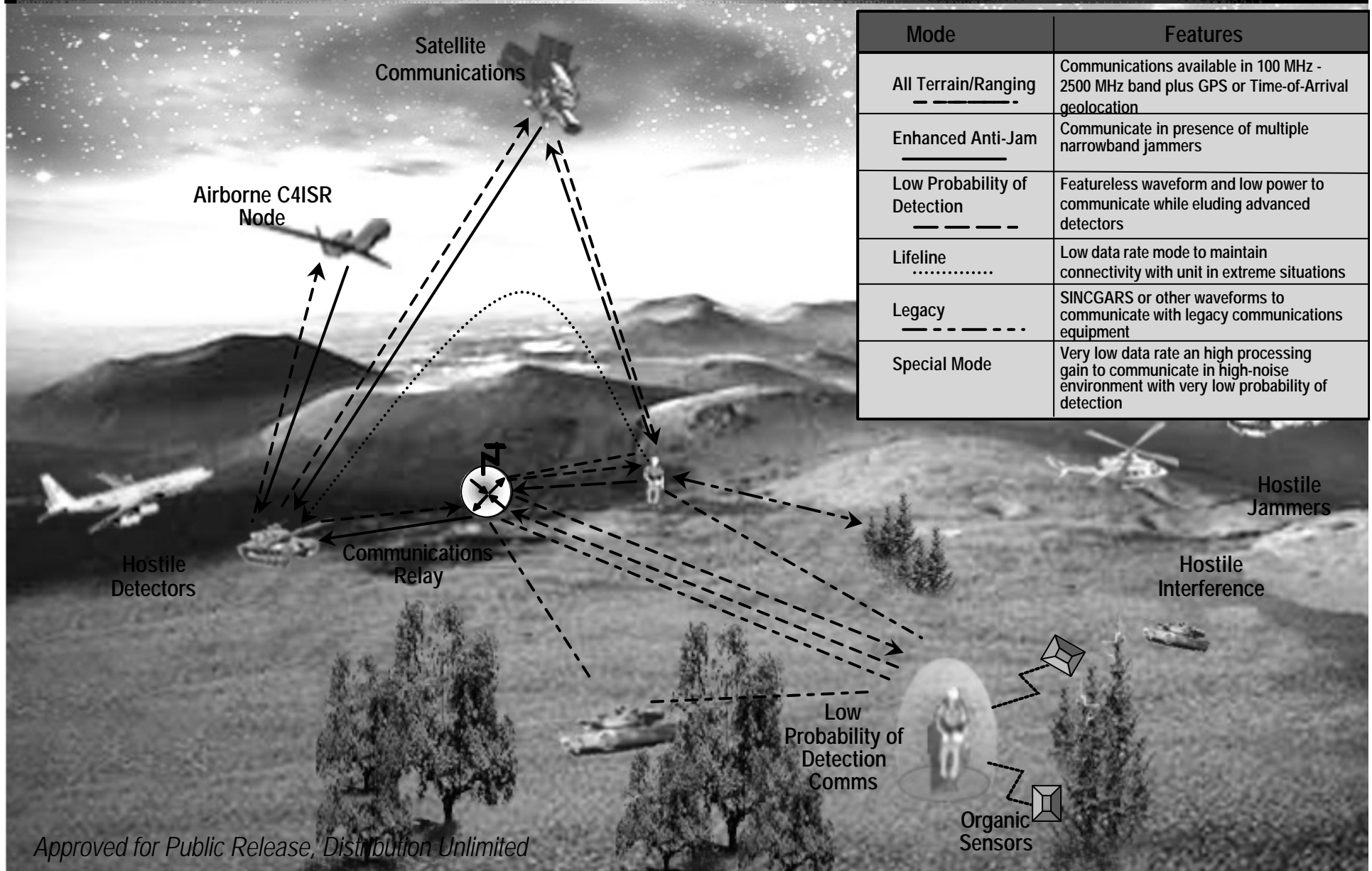
# FCS Technology Programs



# Small Unit Operations Situation Awareness System Concept



# SUO SAS is an Integrated Autonomous Communications Network, Navigation & Tactical Information Source for the Warrior



Approved for Public Release, Distribution Unlimited



# Adaptive C4ISR Node (ACN)



**Functions**  
Communications  
SIGINT  
***SYNERGY!***

## **Features**

Adaptability  
Scalability  
Robust Operation  
Information Assurance  
Seamless Interoperability



# ACN Program



- **Goal: Develop and demonstrate technologies to provide autonomous, assured communications and SIGINT in-theater**
- **Approach: Exploit commonalities between comms and SIGINT; use scalability, modularity to develop platform-independent solution**
- **Phase I (3 teams) started in FY98**
  - Demonstrated narrowband, comms-only proof of concept
- **Down selected to 2 teams for Phase II comms/SIGINT tech development and system design**
- **System design review - Jan. 02; Readiness review - Aug. 02**
- **Transition to Service with CDR-level design and demonstrated system performance in the laboratory (TRL >5)**

# Metal Storm

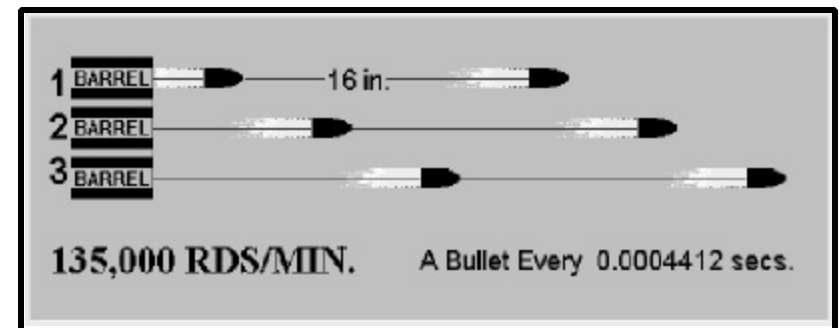
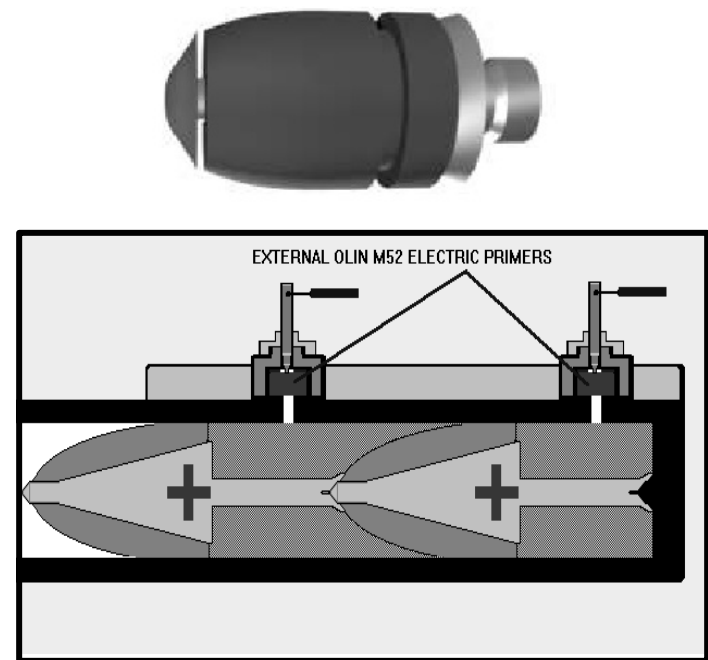


## *Revolutionary New Weapon Technology*

To develop a unique 100% solid state system for:

- tightly packing/ storing / transporting/ firing projectiles in multiple tubes
- electronically variable sequenced rate of fire, up to 1 Mil rds/min

Applications to a wide range of small arms and crew-served weapons for military and law enforcement.



***The System has no conventional equivalent!***

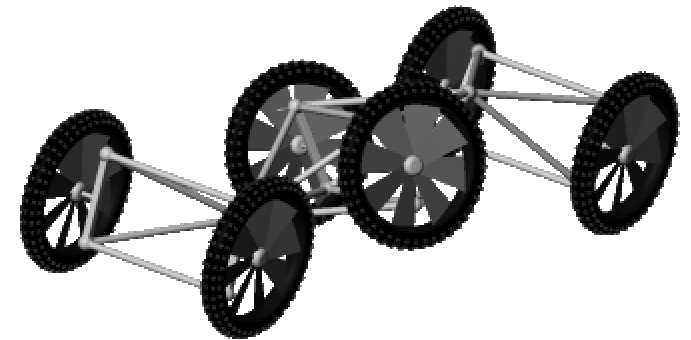


# Uncrewed Ground Combat Vehicle



## Objective: Develop UGVs unrestrained by onboard crew

- mass and volume elimination
- Ride quality and motion limits changes
- Human re-supply eliminated (food, water, fatigue)



## Metrics

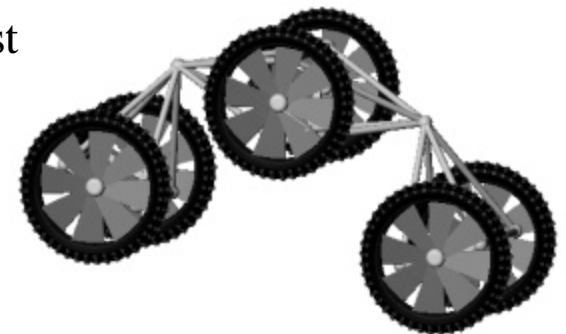
- Endurance (14 days, 450+ km)
- Obstacle Negotiation (~ 1 m)
- Payload Fraction (>25%)

## Retain awareness of:

- Air deployability
- Resilience & reliability
- Signature
- Cost

## Vehicle Classes

- < 1 ton (RST+ payload: 150 kg)
- ~ 6 ton (Weapons payload: 1500 kg)





# PerceptOR Objectives



Develop ground robot perception for off road mobility under a variety of terrain and environmental conditions relevant to FCS.

– **Strong emphasis on experiments in real world environments**



Several unique approaches

- Strong sensor fusion and object classification
- Air/ground coordinated perception
- Learning techniques
- Use of remote sensing data to assist classification
- Active and passive sensing strategies

**Inexpensive Surrogate ATV**



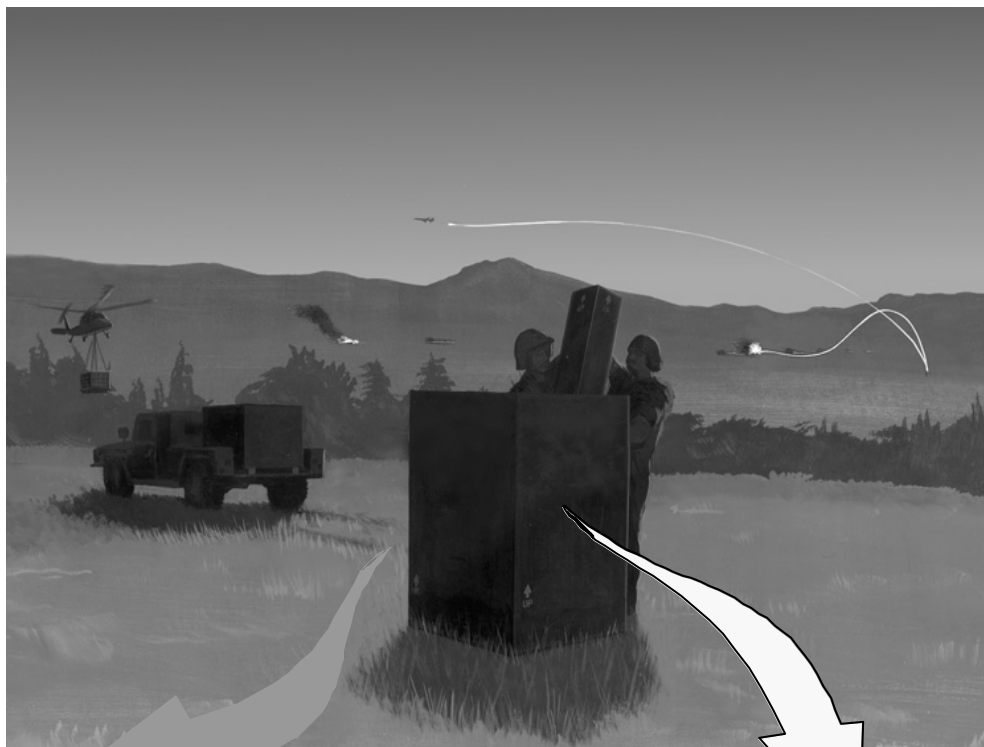


# NetFires

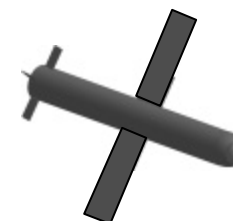


## New Military Capability

- Immediate firepower
- 5x-10x kills per ton vs current ordnance
- Large zone of influence
- Multimode seekers
- In-flight targeting
- Duration weapon
- Can provide BDA and imagery



## Family of Missiles



- Loitering Attack



- Precision Attack

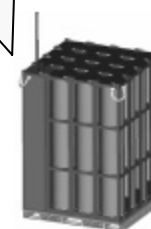
## Designed for Deployability

- Logistic efficiency through containerization
- No platform or crew required



## Low Cost

- Reduced personnel and vehicles
  - LCC reduced > 50%
- CAIV design process
- Commonality of components and assembly



## Modular Vertical Launch

- Self locating / orienting
- Unmanned operation
- Not platform specific
- Can be vehicle appliqué

Extensive testing (brassboard & propulsion, seeker captive flights, launcher, flight and endgame) accomplished prior to April 2003

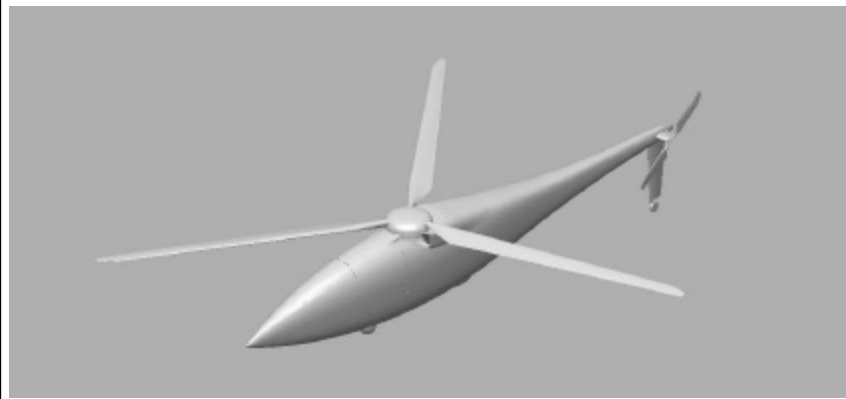


# A160 Program

## Long Range / Long Endurance VTOL UAV



**Advanced Rotor and Flight Control, Lightweight Composite Structure:**  
**2500+ nm Range or 40+ hr Endurance with 300 lb payload**



Rotor Diameter	36 ft
Fuselage Length	35 ft
Payload Weights	300-1000 lb
Takeoff Weight	4000 lb

**Vehicle Currently in Ground Test**

**Demos / Studies for 2003 FCS Decision:**

**SAR/GMTI radar, EO/IR, FOPEN Radar**

**Data Link Network Payloads**

**OAV, UGV, and UGS Deployment**

**Combat Force Resupply**

**All Weather Flight**

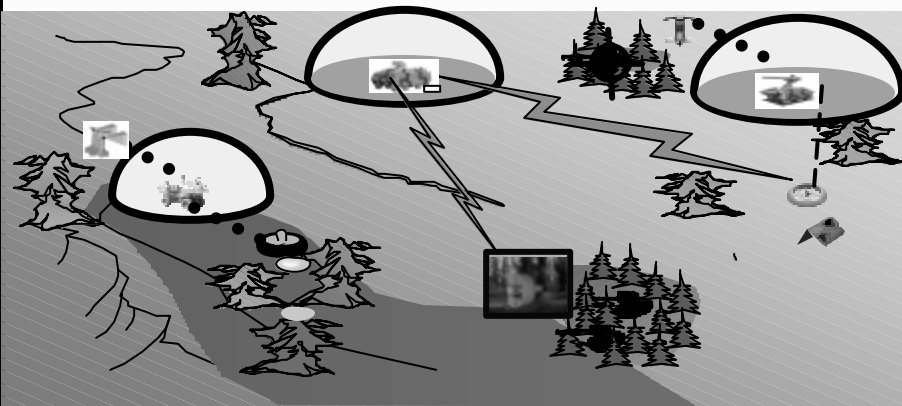




# Organic Air Vehicle (OAV)



## Organic Air Vehicles -- Lower Tier RSTA



## Technical Objectives:

- **Flight stability and control in adverse weather**
- **Highly integrated electromechanical multifunction modules**
  - ➔ Collision avoidance
  - ➔ Guidance, Navigation, & Control
- **Adaptation and integration of useful payloads**
  - ➔ Real time day/night imaging
  - ➔ On-board processing

## Schedule:

	FY01	FY02	FY03
Solicitation released	▼		
Contracts awarded	▲		
Auto GN&C demo	▼ ▲		
Adverse weather demo		▼ ▲	
FCS flight demo			★

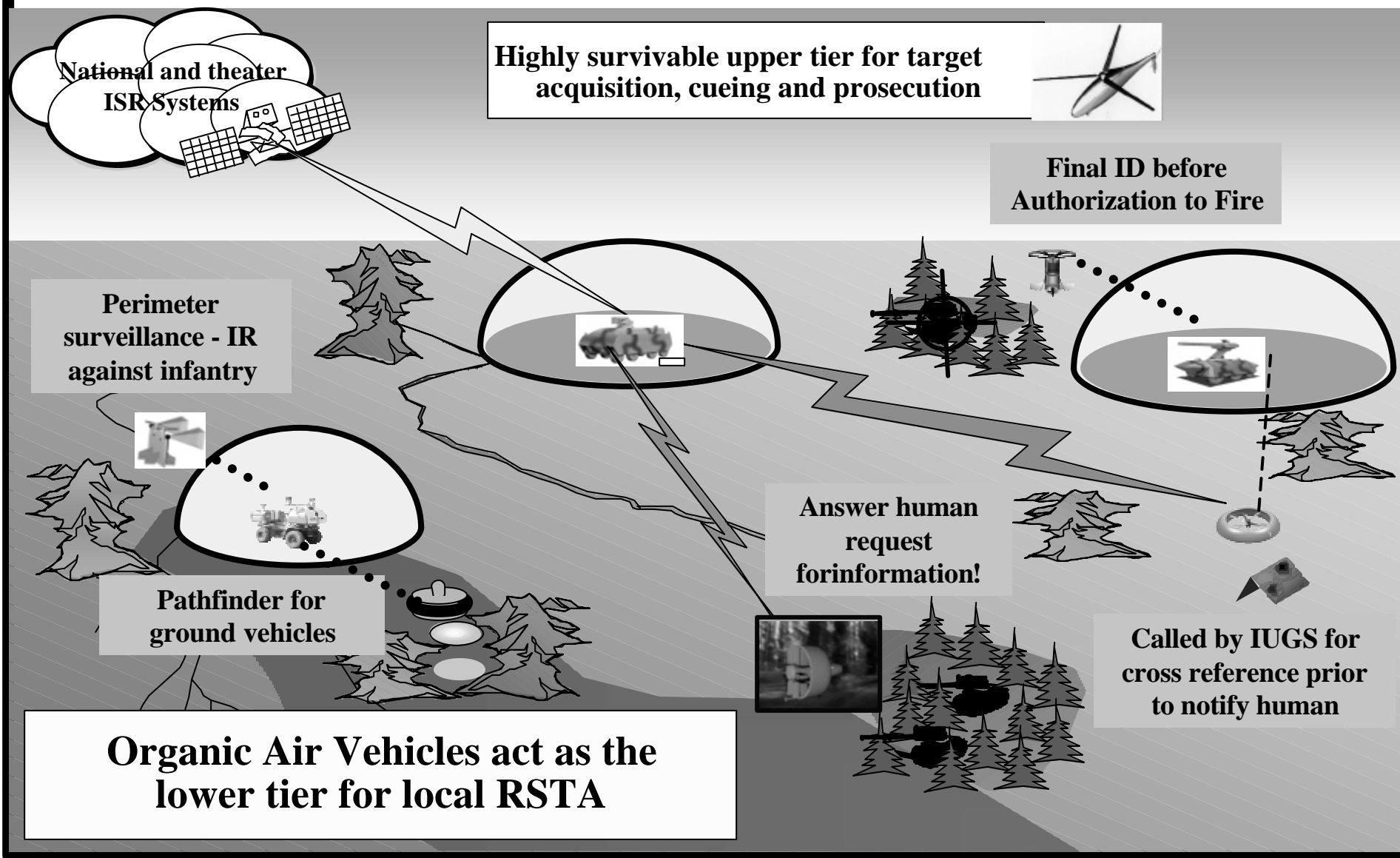
## Military Relevance:

- **Enhances Situational Awareness for FCS Unit cell Operations**
  - ➔ Eliminates latency
- **Users: Army FCS**
- **Enables New Missions in Emerging Warfighting Environments**
  - ➔ Reconnaissance
  - ➔ Perch & Stare



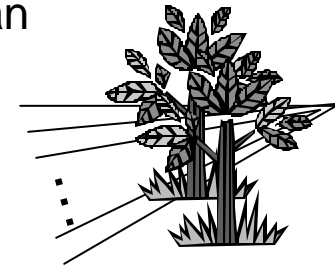


# OAVs on the Battlefield



# Jigsaw: LADAR Sensing for Combat ID

- **Program objective**
  - Develop LADAR systems for reliable combat ID by a human
- **Basic hypothesis**
  - LADAR can enable combat ID through:
    - ♦ 3-D sensing
    - ♦ Combining from multiple viewpoints
    - ♦ “Seeing through” holes in porous material (e.g., foliage)
- **Technical approach**
  - Data collections: Simulations and field collect
  - Trade analyses for multiview LADAR on OAV-type platform
  - Prototype system design
  - Experiments with prototypes
- **FCS Transition**
  - Demonstration of Combat ID using OAV scenarios
  - Stressing targets (in hide, urban, etc.)



## Approach

Attempting to integrate the stove-piped Battlefield Functional Areas

## Top Technical Challenges

- Developing an integrated C<sup>2</sup> architecture derived from selected BFAs for a FCS unit cell
- Insuring connectivity to an FCS Commander through an interactive display

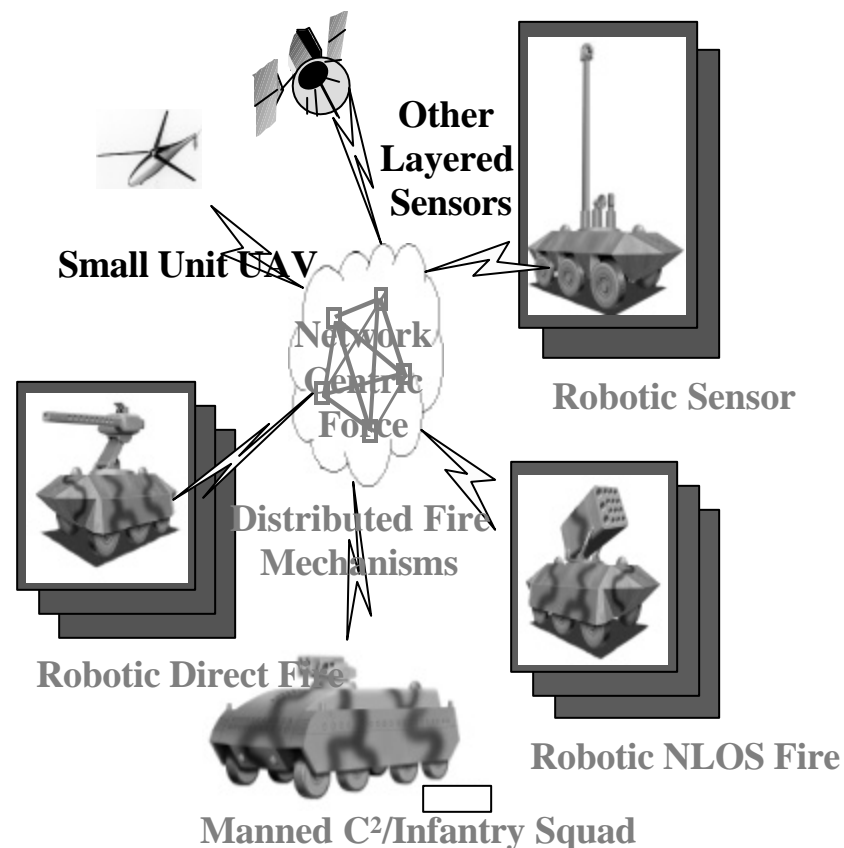
## Users

- Objective Force units
- Connectivity to legacy units

## Goals

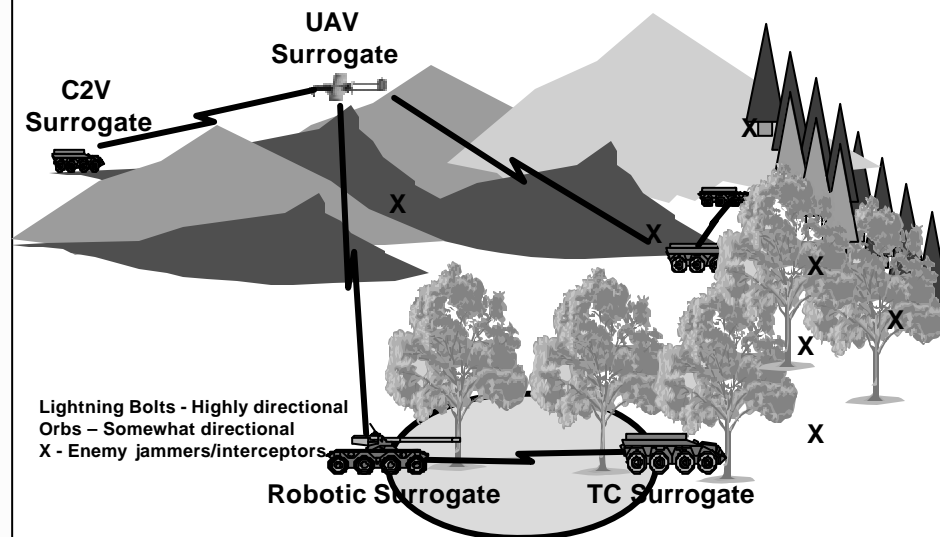
FY03

- Develop an integrated scaled C<sup>2</sup> Architecture
- Simulate and demonstrate a C<sup>2</sup> element of a Unit Cell



## Goal

- *Provide assured, high data rate networked communications that is LPD and A/J with quality of service for real-time and non-real time applications in a heterogeneous environment with 1000s of nodes.*
- *Demonstrate Notional FCS Cell at TRL-5 for PDR by 15 Apr 03*
- *Show Scaling Across Multiple FCS Cells in Simulation by 15 Aug 03*



## Technical Challenges

- High Data Rates for Low Latency Real-Time Traffic (Robotic and Fire Control)
- Low Probability of Detection (Sensor to Decision Maker)
- Anti-Jamming (Decision Maker to Shooter)
- Seamless, Multi-band Mobile Ad Hoc Networking with Directional Antennas
- Quality of Service for Real-Time and Non-Real-Time Traffic
- RF Information Assurance (Network Layer and Below)



- **Backup slides**





# FCS Concept Development



- **DARPA Program Manager**
  - LTC Marion Van Fosson, USA
- **Four contractor teams**
  - The Boeing Team
  - Team Gladiator (Consortium)
  - Team Full Spectrum
  - Team FoCus Vision (Consortium)

# FCS Major Technology Challenges



- **Autonomous Unmanned Ground Vehicles**
  - Uncrewed Ground Combat Vehicle
  - PerceptOR: Perception for Off Road Mobility
- **Maneuver BLOS**
  - Networked Fires (NetFires)
- **Organic All-Weather Targeting Vehicles & Sensors**
  - A160
  - Organic Air Vehicle
  - JIGSAW: LADAR Sensing for Combat ID
- **Networked Command, Control & Communications**
  - Integrated C2 Architecture
  - FCS Communications





# UGCV Status



## Awarded 8 Agreements in January

### RST and Weapons Categories Studies



### Weapons Category Study

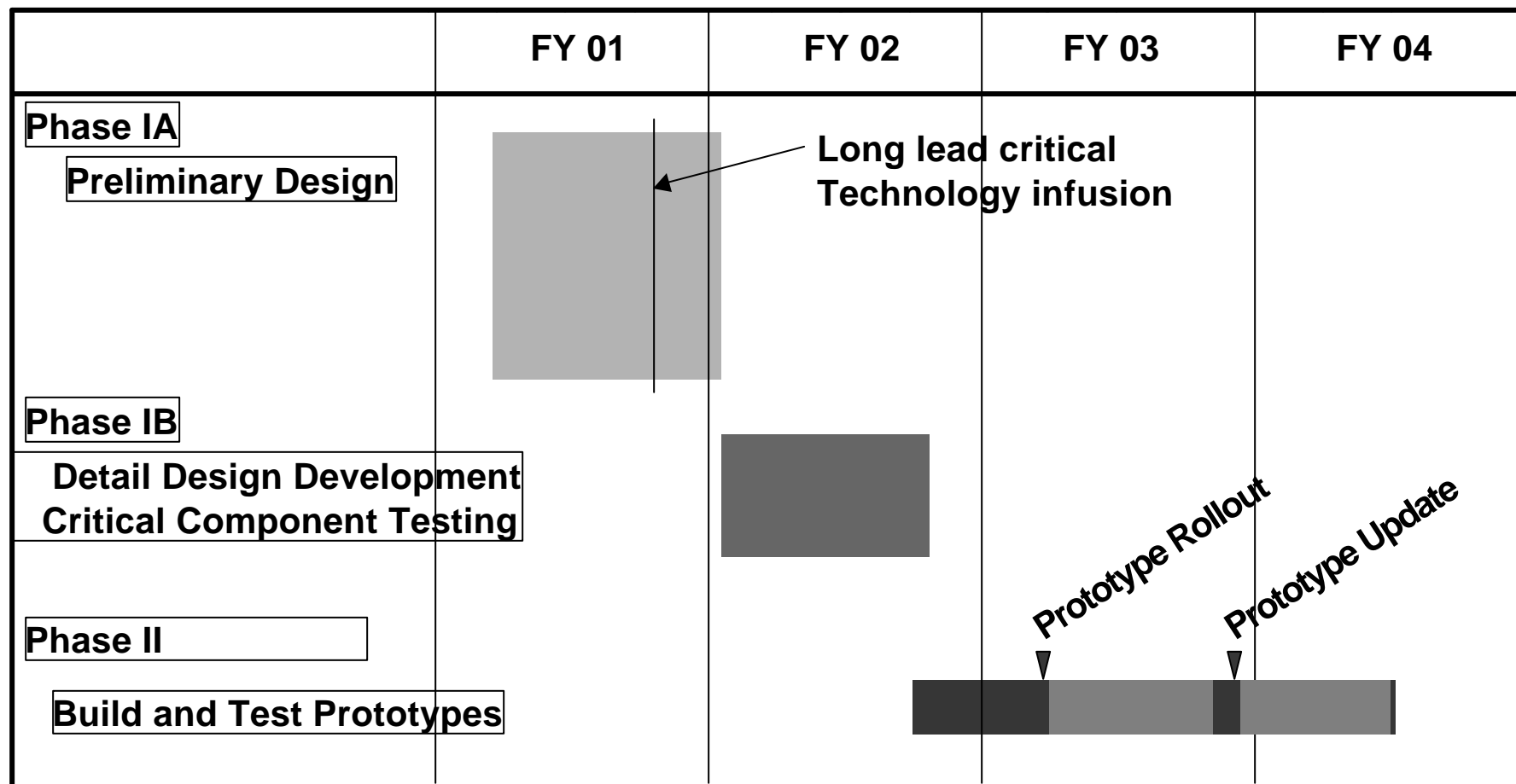


### RST Category Study





# UGCV Plan

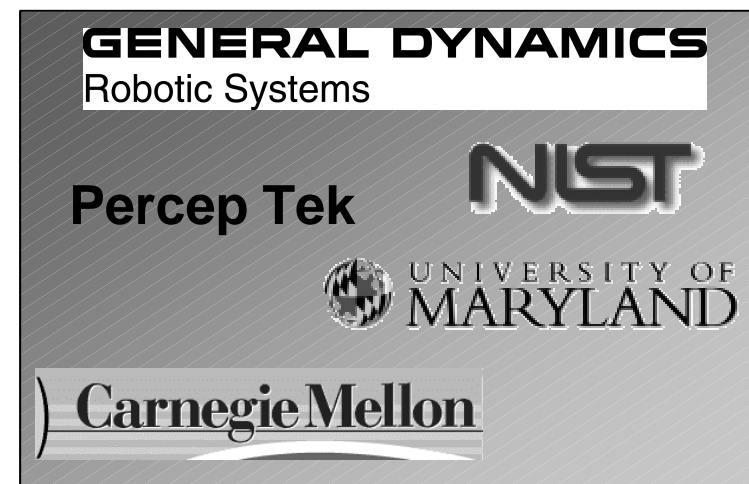
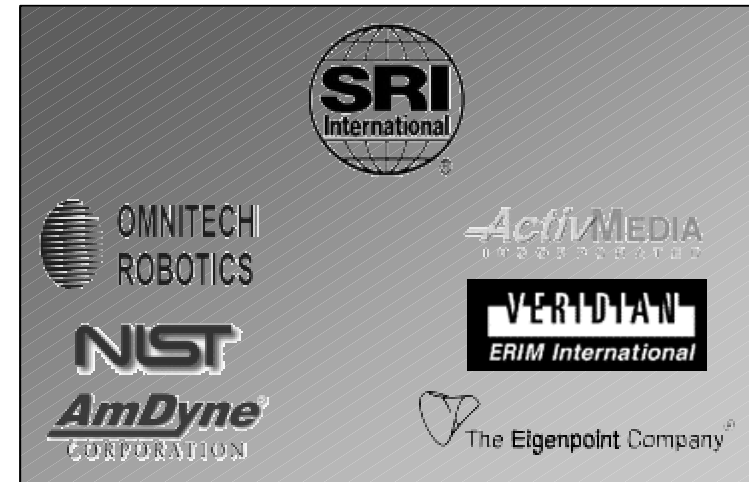




# PerceptOR Teams



Awarded 4 Agreements in March 2001





# PerceptOR Plan

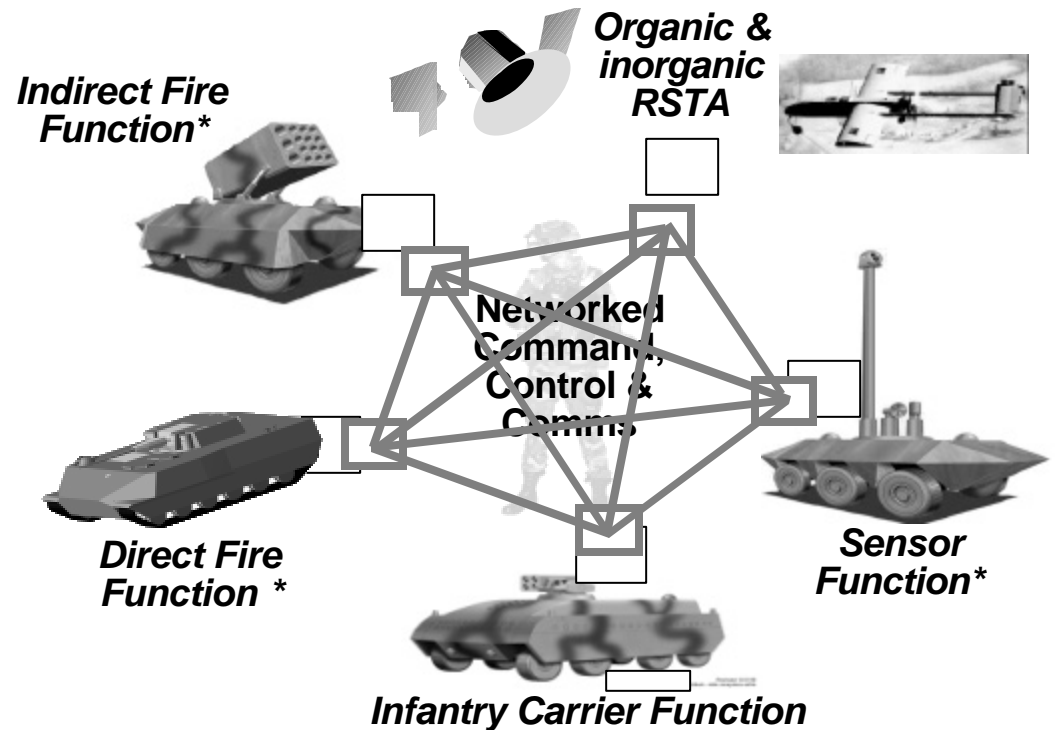


	FY 01	FY 02	FY 03	FY 04
<b>Phase I</b> Test Critical Components Outfit Surrogate Vehicles				
<b>Phase II</b> Developmental Testing Unrehearsed Evaluation Experiments in various terrain				
<b>Phase III</b> Update Perception Prototypes Unrehearsed Experiments in degraded conditions				

# Major Technology Challenges



- **Autonomous Unmanned Ground Vehicles**
- **Maneuver BLOS**
  - Networked Fires
- **Organic All-Weather Targeting Vehicles & Sensors**
- **Networked Command, Control & Communications**



\* Manned or unmanned